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ABSTRACT

Presented is the framework of science programs for Texas public schools, K-12. This publication consists of four major sections in addition to an introduction which includes the rationale for developing this science framework and the function of the science curriculum. The first section presents 15 topics along with 36 suggested module titles and specified learner objectives for kindergarten through grade 5. A matrix correlation chart and a science content/process chart are also included. The second section presents a science framework for middle school, grades 6-8. Requirements and course suggestions are also included. The third section presents science framework for high school, grades 9-12. Requirements for graduation, minimum offerings by a school district, and course suggestions are also included. The fourth section presents an appendix which includes approved courses for grades 7-12, science framework matrix, and suggested procedures for implementing the science framework. (HM)

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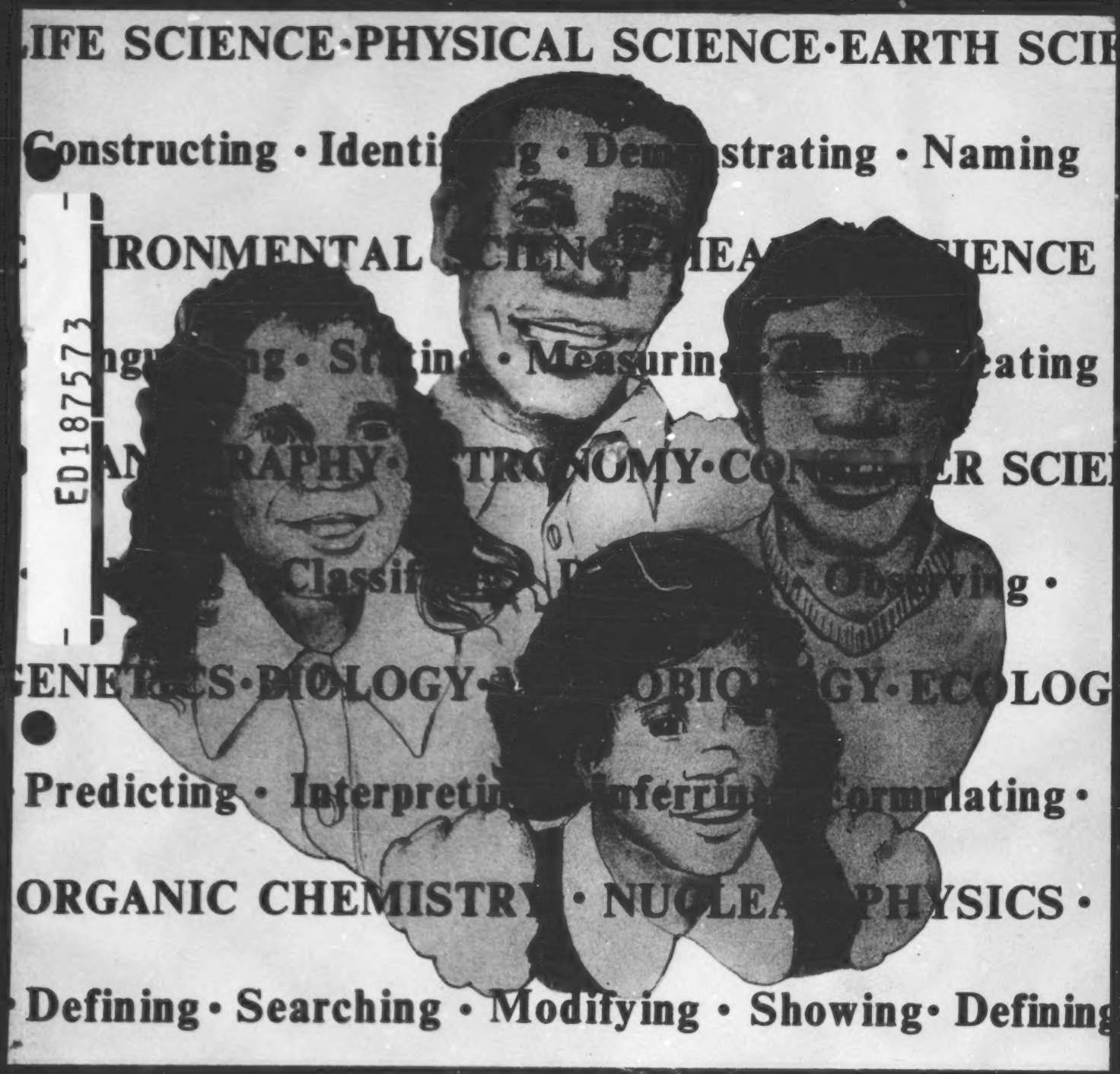
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SCIENCE FRAMEWORK
Kindergarten Through Grade 12

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FOREWORD

This framework has been prepared to aid school administrators, curriculum producers, and teachers in upgrading the science education program in Texas public schools, kindergarten through Grade 12.

For kindergarten through Grade 5, the framework organizes science instruction in a modular format. The modules are instructional blocks designed to sequentially build the student's knowledge base and thinking skills

The semester system (65 instructional clock-hour time block) is advocated in the middle school, Grades 6-8. Course suggestions have been expanded to allow schools flexibility to match instruction to the requirements of students.

In the high school, Grades 9-12, semester system courses are used (80 clock-hour block). Traditional courses for the college-bound student are continued. However, applied courses for Physical Sciences, Biology, Chemistry, and Physics have been added. These courses emphasize applications of science in our everyday life.

We hope that this publication, *Science Framework, Kindergarten Through Grade 12*, will promote activity-oriented science programs that will stimulate students' active interest in science and technology.

Alton O. Bowen
Commissioner of Education

ACKNOWLEDGMENTS

A committee of Texas science educators, appointed by the commissioner of education, met in 1973 to write an initial draft of a new framework for science. Members of the science staff of the Texas Education Agency served as resource persons to the writing group.

The initial committee members were:

Rolland R. Bartholomew	University of Texas at Austin
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Vaden P. Hiner	Abilene Independent School District
Earl J. Montague	University of Texas at Austin
Joseph Strehle	Region IV Education Service Center

A group of science educators was appointed to consider the feedback from several hundred teachers who evaluated the initial draft and suggested changes in the document. Appreciation is extended to the persons listed below as well as to members of the initial writing committee, and to the hundreds of other educators who have read the publication, tried the ideas, and made suggestions for change for a more effective science framework.

The educators responsible for analysis of the feedback were: Lawrence Buford, Austin ISD; Frank Butcher, Deer Park ISD; Louise Goode, Midland ISD; Delmar Janke, Texas A&M University, Elaine W. Ledbetter, Pampa ISD; Mike Owens, Nacogdoches ISD; Ralph Ritchie, Houston ISD; Charles Rose, El Paso ISD; George R. Schelkopf, Texarkana ISD; Garline Shaw, Dallas ISD; Gerald Skoog, Texas Tech University; Virginia A. Stacey, Lackland ISD; Fernando Vasquez, Laredo ISD; Tom Weldon, Pittsburg ISD; and Robert Woll, El Paso ISD.

The present draft of the framework was compiled by the Agency science staff using suggestions from teachers and administrators from over the state as well as from a committee of members of the Science Teachers Association of Texas (STAT). Otis Smith of Deer Park ISD was chair of the STAT Committee. Other members were Helen Shafer, Dallas ISD; Charlie Rose, El Paso ISD; Betty Elvin, Cold Spring ISD; and Gwen Keith, Cypress-Fairbanks ISD.

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RATIONALE

Today's focus in the schools is on students — their worth, their dignity as individuals, and their relationships to the society of which they are a part. One of the great needs today for both the individual and for society is for individuals to be able to formulate goals and objectives that enable them to work toward the solution of problems, both their own and those of society. This ability to formulate goals and objectives which lead to problem solutions calls for students who are knowledgeable about the makeup of their environment and who understand the dynamics and interactions which keep it in balance. Additionally, the deliberate methods they employ in finding solutions to problems enable them to develop a greater understanding of themselves and effective ways to live within a society as they make reasonable career choices, make prudent consumer decisions, and seek to derive full enjoyment from wise uses of leisure time.

Students change as they learn. Because of the applications of processes in the acquisition of knowledge and psychomotor skills, they better understand relationships and natural phenomena. Moreover, they modify their perceptions of the ways people interact and the ways society functions. These changes in students, increased knowledge, and the modification of their perceptions increase the probability of a greater understanding of themselves and society. This increased understanding of self and society enhances the probability of their acquiring values, attitudes, and aspirations that enable them to identify their roles in society.

A school curriculum that allows for student discovery and subsequent changes will make education meaningful for problem-solving in everyday life.

An activity-oriented science program brings students and science together. The resultant interaction of the student with science and the interaction of the student with other students as they together interact with science can take place in an atmosphere that promotes the identification of problems and the development of solutions.

In addition, in an activity-oriented science program, teachers combine the process of science (those activities that scientists engage in) and the product of science (the knowledge resulting from the activities of the scientists) in an experience base which offers the student unusual opportunities to develop those skills important in acquiring and in applying knowledge. This experience base, and the skills used in acquiring it, can also be used in formulating explanations of self and society and the relationships of one to the other.

This publication has as its major purpose the task of identifying and describing the function of an activity-oriented science curriculum. This function is to help all people understand the relationship between what one gains in the study of science and the life experiences in which this learning is applied.

THE FUNCTION OF THE SCIENCE CURRICULUM

With the many challenges facing society today, it is important that science be taught in a way that will give each student knowledge and a sense of confidence in his or her ability to size up situations, to consider alternatives, and then to decide on a course of action. If students are to develop confidence in their ability to do this, they should be encouraged to consider alternative solutions and to recognize that answers might best be sought within the context of the problem rather than in relying on an authority, such as the teacher or a textbook. That is, they need to learn a pattern of delaying responses and of tolerating uncertainty when evaluating various hypotheses. Students accustomed to working on a problem until they get the "right" answer should learn to face situations where there are few "right" answers, only "better" answers.

Science is indeed a part of American culture and civilization. It helps people grow and change. It impacts upon our society and brings about changes in ways of living. Every citizen should come to some understanding of the influence of science on national policy; on the thought of the times; on economic, social, and political problems; and on the life of each person.

The science curriculum exists to help young people know about and participate in the life of their time. How can this occur if learners become strangers to their technological culture? It is vital that the science curriculum consider not only the knowledge which has arisen from the scientific enterprise, but, additionally, the nature of the scientific enterprise itself and its interactions with society. An effective science curriculum should consider the social implications of the scientific enterprise.

Each individual is a unique human being, having specific needs, attitudes, and abilities. The science curriculum must reflect a recognition of this fact. If human beings are to use independent judgment which considers and respects the rights of others, it is important that the learning environment provide for differences between individuals. This implies some degree of individualization within the classroom and also more flexibility in curriculum requirements. It is only in this way that students learn under their own initiative and develop an interest in doing so. The fact that each individual is unique further implies that the science curriculum must respond to students who are culturally different and to those who have career aspirations of a scientific nature as well as those who seek careers unrelated to science.

Words facilitate the development of concepts only when the ideas they represent are understood in terms of the real world. Verbalization without understanding can only hinder concept development. This is the danger of attempting to teach science concepts through definitions and names. The ability to verbalize a concept is not a guarantee that the learner can apply or relate the concept. It is wasteful to teach facts divorced from a meaningful context. The test of learning should always be the extent to which a student is able to apply concepts and conceptual patterns in new situations. This implies that students be provided a wide variety of experiences within the science curriculum. These experiences should allow application of concepts toward the solution of problems that may be of concern to students as individuals living in our present society.

ELEMENTARY SCIENCE FRAMEWORK
Kindergarten — Grade 5

INTRODUCTION

This section, the Elementary Science Framework, has been developed from assumptions about individuals, society, and schools consistent with ideas presented in the Rationale and in the Function of the Science Curriculum. Fifteen topics have been developed encompassing 36 modules with accompanying learner objectives to serve as a model for schools to use in constructing their own science curriculum for K — Grade 5. School personnel will want to add to the suggested 15 topics to meet the interests and needs of local students.

To help provide for these interests and needs, instructional materials in the state adopted textbooks can be utilized in teaching the suggested topics.

ORGANIZATION

The section is organized into three components.

Component One, "Elementary Science Framework," presents 15 topics along with 36 suggested module titles and specified learner objectives for kindergarten through Grade 5. This component is subdivided into kindergarten, primary, and intermediate levels in keeping with the degree of sophistication of the content-process skills involved. In addition, the topics are keyed to appropriate cells within the Science Framework Matrix (page 60).

Component Two, "Matrix Correlation Chart" (page 19), depicts the cells within the Science Framework Matrix (page 60) that are pertinent to relating life and science for children in the elementary school. It is noteworthy that of the 20 cells within the Matrix, 11 contain one or more module topics which are examples of science experiences in the K — Grade 5 curriculum.

Component Three, "Science Content/Process Chart" (page 20), shows the emphasis of science content and thinking skills or processes in the topics listed in Component One.

COMPONENT ONE: ELEMENTARY SCIENCE FRAMEWORK

KINDERGARTEN TOPICS

Topic 1: Describing Static Systems Involving Shape and Color

Matrix-Correlation Chart emphasis:

A-2 Organization of Thought Processes
B-3 Use of Basic Materials
D-4 Hobbies and Recreation

Science Content/Process Chart emphasis:

Process: observing
Content: life sciences, physical sciences, mathematical sciences

Module

What's My Name

Through the varied activities of this module, children have the opportunity to draw themselves; name their body parts; and look at and feel many objects in their environment, such as clothes, geometric shapes, pipe cleaners, mystery bags, and toy animals.

Objectives

- Identify and name colors of objects.
- Identify and name two-dimensional shapes.
- Construct classifications of objects based on texture, color, or shape.
- Identify objects based on color, shape, or size.

Module

Shapes Around Me

Surrounding each child are many things that he or she sees but does not know how to name. A significant contribution to the young child's development is the ability to describe precisely the shape of these things. Through a variety of experiences with toy animals, dot-to-dot drawing, strings and shadows, and coded messages, children acquire new tools of describing.

Objectives:

- Construct and name the following two-dimensional shapes: triangle, circle, square, rectangle, and ellipse.
- Identify the following three-dimensional shapes: sphere, cube, pyramid, and cone.
- Identify and name the two-dimensional shapes that are components of regular three-dimensional shapes.
- Demonstrate an arrangement of self and others in the form of two-dimensional shapes.

Topic 2: Using the Senses

Matrix-Correlation Chart emphasis:

A-2 Organization of Thought Processes

Science Content/Process Chart emphasis:

Process: observing
Content: life sciences, physical sciences

Module

New Tools for Seeing

When we learn, we have many possible sources for information other than our eyes. Through experiences with similar and contrasting foods and smells, children begin to develop simple classifying and verbal skills.

Objectives:

- Distinguish among certain food tastes as similar to or different from each other.
- Identify tastes that are sweet, sour, or salty.
- State that certain objects do have an odor or they do not.
- Identify groups of objects as having similar or different odors.

Topic 3: Observing Living Things

Matrix-Correlation Chart emphasis:

C-1 Consideration of Consequences

Science Content/Process Chart emphasis

Process: observing
Content: life sciences

Module

Group of Things

Being able to identify and to describe how a group of diverse objects are similar or different represents a key goal in intellectual growth. Collections of plastic fruit, pictures, comic strips, grab bags, buttons, toy cars, nuts, leaves, or shells are just some of the wide variety of items that can be used to make learning fun and meaningful for young children.

Objectives:

- Identify sets of objects when given the name or characteristics of their members.
- Identify or construct sets of objects based on child's choice of characteristics.
- Identify a member of a set and name characteristics common to the members of that set.
- Identify, name, or order the number of members of a set up to 12.

Topic 4: Describing Comparisons

Matrix-Correlation Chart emphasis:

A-3 Competence in Handling Materials
C-3 Mechanical Aptness

Science Content/Process Chart emphasis:

Process: measuring, communicating
Content: life sciences, earth sciences, physical sciences

Module

Putting It in Order

Describing their environment requires that children do more than just state what they see. They need to quantify their experiences in terms of how much or of how many. Finding pairs of things in the room, taking ecology walks, and examining a variety of sets of things and pictures make beginning activities in these mathematics-related skills useful.

Objectives:

- Identify as equivalent the sets which contain the same number of members.
- Order sets in terms of the fewest members or the most members.
- Identify and name the order position of an object or event.

Topic 5: Children Observe and Describe Themselves

Matrix-Correlation Chart emphasis:

A-1 Belief in Myself
A-4 Mental and Physical Well-Being
E-2 Constructive Adjustment

Science Content/Process Chart emphasis:

Process: observing
Content: life sciences

Module

On the Move

Understanding directions as they apply to themselves and others is a challenge for young children. Children use directions in contexts that fit their readiness, especially with games such as Simon Says and May I, songs such as "Looking Lo" and "Heads and Shoulders, Knees and Toes," and activities using arrows, flags, and animals in aquariums.

Objectives:

- Identify the movement associated with each of these terms: **up, forward, back, right, left.**
- Identify right and left parts of the body.
- Distinguish between objects that are moving and those that are not moving.
- Identify directions of moving objects.

Topic 6: Classifying Objects and People

Matrix-Correlation Chart emphasis:

- A-1 Belief in Myself
- A-2 Organization Thought Processes
- A-4 Mental and Physical Well-Being
- B-3 Use of Basic Materials
- E-2 Constructive Adjustment

Science Content/Process Chart emphasis:

Process: classifying
Content: life sciences, earth sciences, physical sciences, mathematical sciences

Module

Classifying Your Observations

In selecting a common similarity among such things as buttons, shoes, and sounds, children have opportunity to show their creativity in classification skills.

Objectives:

- Distinguish an object or event from others that are similar, and identify how they are similar or different.
- Construct a classification of objects based on physical characteristics.
- Construct a classification of objects based on function of objects or feeling associated with the objects.

Module

Telling About Me

The more complete a child's description, the more likely it will be successfully communicated to another person. Geometric shapes, symmetry, living-nonliving schemes, and shadows are vehicles for enabling children to both perceive and verbalize their observations.

Objectives:

- Identify two- and three-dimensional shapes in objects.
- Identify and demonstrate symmetry in objects.
- Identify and name characteristics common to a group.
- Construct a classification of objects based on observable characteristics such as "living" and "nonliving."
- Identify three-dimensional objects based on their two-dimensional shadows.

Module

Living Sets

Taking field trips around the school building and studying animals and their babies, pairs of real and artificial animals, aquariums, and toys can be productive for children as they develop classification concepts.

Objectives:

- Describe a living or nonliving object according to several of its characteristics.
- Demonstrate a separation of inanimate objects or living organisms commonly found in an aquarium into sets and subsets.
- Construct and demonstrate the use of a simple classification system.

Topic 7: Observing and Describing Changing Events

Matrix-Correlation Chart emphasis:

A-2 Organization of Thought Processes
C-1 Consideration of Consequences
E-1 Concern for People

Science Content/Process Chart emphasis:

Process: observing, measuring, communicating
Content: life sciences, earth sciences, physical sciences, mathematical sciences

Module

Temperature and Time

Searching for a variety of words for **right now** is one way to initiate children's awareness that in most of science many answers are appropriate. Time wedges and termperature contrasts are useful beginning points for development of comparison skills and language—the initial step in measurement.

Objectives:

- Distinguish time intervals with or without the use of a clock or calendar.
- Distinguish temperature intervals with or without the use of a thermometer.
- Identify a correct time or temperature using a record or chart.

Module

Observing Change

Children constantly are surrounded by changes, and yet they may never see them. Children have opportunities to observe changes in relatively brief time periods during experiences with making popcorn, frying bacon, observing the growth of mold, extracting the color from red cabbage, and observing the fermentation of garbage.

Objectives:

- Name the temperature in degrees.
- Construct and demonstrate how to use a chart of weather conditions.
- Describe comparisons of weather conditions.

Module

Animals in Motion

The power of a single concept — stimulus-response — in helping to describe how an animal moves and some reasons for its moving is apparent in these activities. Children can develop a concept of stimulus-response in working with aquariums, pets, hamsters, frogs, rabbits, turtles, earthworms, and snakes.

Objectives:

- Distinguish a stimulus from a response.
- Describe how an animal moves using the term **push**.
- Identify parts of the animal which it uses in pushing.

Topic 8: Quantifying Observations or Measuring

Matrix-Correlation Chart emphasis:

A-2 Organization of Thought Processes
A-3 Competence in Handling Materials
B-3 Use of Basic Materials
C-3 Mechanical Aptness
E-3 Safe Practices

Science Content/Process Chart emphasis

Process: observing, measuring
Content: life sciences, mathematical sciences, physical sciences

Module

Measuring Things

When comparing objects or events, it is important to select the unit appropriate to what is being measured. Dimensions of the room, hands, and balls and lengths of races are all contexts for children to become at ease with metric measurement.

Objectives:

- Demonstrate how many times a measuring stick can be laid end to end along a given length that is to be measured.
- Name the results of measurements in whole metric units or as between two whole number units.
- Name three metric units of linear measure (the centimeter, the decimeter, and the meter), and demonstrate the approximate length of each.
- Distinguish between the weight of objects based on how far the objects cause a third object to move.
- Demonstrate a procedure for measuring and recording changes in the posit on of various objects.

Module

How Much?

In addition to learning to compare and measure linear dimensions, young children have the challenge of learning to measure both area and volume. Fascinating activities involving comparisons of area and volume include working with animal foot prints, making shadows on butcher paper, and comparing containers filled with dried beans.

Objectives:

- Order objects based on visual perception of their volume or area.
- Order objects based on comparison with other units of volume or area.
- Identify or name comparison in volume or area for a set of objects.

Module

The Shape of the Angle

When children visualize how to cut a birthday cake to get the most icing, they become involved in inferring shapes of objects. there are many actions children can visualize that involve the sections of objects. Other activities in which children can study angles involve the projection of light through different-shaped prisms.

Objectives:

- Identify or construct the shape of three sections of an object: transverse, longitudinal, or slant.
- Construct inferences about an object's shape or section, given a description of the shape of its section or shape.
- Identify and measure angles of incidence and reflections of light on mirror images.

Topic 9: Communicating Skills Through Graphs and Charts

Matrix-Correlation Chart emphasis:

A-2 Organization of Thought Processes
B-3 Use of Basic Materials

Science Content Process Chart emphasis:

Process: measuring, classifying, communicating
Content: life sciences, physical sciences, mathematical sciences

Module

Communicating Numbers

Number lines are a useful tool to help children communicate events in relationship to one another. In graphs, using number lines is even more essential. TV schedules, a clock, negative numbers, and the White Rabbit pocketwatch from *Alice in Wonderland* are possible resources to use for this module.

Objectives:

- Name the time using numerals and given data.
- Order negative integers.
- Demonstrate finding the sum and name the sum of one-place integers.
- Name or identify the days or hours before or after a particular event.

Module

Pictures That Tell

Constructing graphs based on data about birthdays, food preferences, a button collection, experiments with spring stretches and seesaws, and races are fun. Graphs themselves are an effective tool by which children can picture relationships in their observations.

Objectives:

- Construct a graph.
- Identify and name fractional parts using decimals.
- Identify and name distances or positions on a map.

Topic 10: Distinguishing Observations and Explanations

Matrix-Correlation Chart emphasis:

- A-2 Organization of Thought Processes
- A-4 Mental and Physical Well-Being
- C-2 Product and Service Selection
- E-2 Constructive Adjustment

Science Content/Process Chart Emphasis:

Processes: observing, classifying, predicting, inferring
Content: physical sciences, mathematical sciences, life sciences

Module

Explanations and Evidence

Distinguishing what one actually sees from conjectures about what one sees represents a challenging task for most children (and adults). Utilizing birthday packages, mystery boxes, plants, and games of 20 questions are ways that children can be involved in both making observations and then constructing inferences based on these observations.

Objectives:

- Distinguish between observations (evidence) and inferences (explanations).
- Describe changes in an event and state an inference.
- Construct inferences in terms of likelihood rather than certainty.
- Identify inferences which need additional observations (evidence) for support.

Module

Fact or Opinion

Opinions vary, but their basis may remain the same. Using cartoons and animal tracks are two ways to enable children to practice the application of systematic thinking to a variety of high-interest contexts.

Objectives:

- Distinguish between observation and inferences.
- Construct inferences from observations.
- Describe observations and situations to test inferences.
- Modify inferences on the basis of additional observations.

Module

Predicting What Happens Next

A collection of challenges using swinging pendulums, magnets, paper wads, and bouncing balls makes developing the skill of observing and predicting fun. Graphs, essential tools for systematic thinkers, are part of these experiences.

Objectives:

- Construct a prediction about an event based on observations of that event.
- Construct a prediction about an event based on data from a graph.
- Describe a test for a prediction.

Topic 11: Sensing the Question

Matrix-Correlation Chart emphasis:

A-3 Competence in Handling Material

Science Content/Process Chart emphasis:

Processes: measuring, communicating, constructing operational definitions, interpreting data, formulating hypotheses.
Content: physical sciences, earth sciences, mathematical sciences, life sciences

Module

Seeing the Whole Picture

Arrows as part of pictures of force are tools to add dynamics to children's communications and focus to their interpretations. Toy cars, tugs-of-war, and balancing acts are some of the functional stimuli that enable children to learn how to make their data records more complete.

Objectives:

- Construct two-dimensional pictures of three-dimensional objects as viewed from different perspectives.
- Name the forces necessary to cause objects to move.
- Construct pictures of forces — arrows or vectors — acting on moving objects.

Module

Who or Why Am I?

Building hypotheses or generalizations requires both skill in collecting data and perceptivity in seeing patterns in that data. Using PTC (phenylthiocarbamide) paper, dog families, and pickles, children build concepts about inherited characteristics.

Objectives:

- Construct a hypothesis given a set of data.
- Identify data which supports or does not support a hypothesis.
- Describe a way to test a hypothesis.

Module

Communicating Through Pictures

Push-rod boxes and contour mapping can be used tc enable children to select significant data to include in their records or pictures. Three-dimensional tick-tack-tow adds a flavor of challenge to these activities.

Objectives:

- Given data or descriptions about an object or its function, construct an inference about that object.
- Construct a two-dimensional representation of a three-dimensional object.
- Identify and name positions that specify points on a three-dimensional graph.

Topic 12: Defining Terms and Variables

Matrix-Correlation Chart emphasis:

A-3 Competence in Handling Materials
E-3 Safe Practices

Science Content/Process Chart emphasis:

Processes: classifying, predicting, inferring, constructing operational definitions, defining variables, interpreting data, formulating questions
Content: earth sciences, physical sciences, life sciences.

Module

Analysis of Objects

The analysis of minerals and rocks is intriguing to most children of all ages. The use of mystery powders and punch card data record-keeping systems is in itself an interesting way to help children focus on specifying variables.

Objectives:

- Distinguish between similar objects using observable characteristics.
- Construct and demonstrate the use of a classification system based on observable characteristics or on changes in materials.
- Identify an unknown using a classification system.
- Construct an operational definition and use it to identify or distinguish between solutions or mixtures and substances which are not solutions or mixtures.

Module

Change and How to Make It

Forming operational definitions of an event and identifying the significant variables in that event are important challenges to children's science investigations. In experiences with seeds, plants, water tubes, and candles, children design experiments and define what variables they wish to control or maintain constant.

Objectives:

- Construct inferences about an event based on observations.
- Construct a test of an inference.
- Construct predictions based on a series of observations.
- Construct a revision of a prediction based on new data.

Module

Operational Definitions

Developing definitions that specify what to look for and how to know you have found it are part of children's needed skills in science. Magnetic fields and true north based on shadows are two high-appeal investigations.

Objectives:

- Name a conclusion based on an inference made from observational evidence.
- Construct one or more inferences to account for observational evidence.
- Demonstrate the use of an operational definition.

Module

Changes

Designing investigations such as those involving mold or loss of moisture from potatoes provides children with the need to make careful plans. The intellectual challenge in being specific in one's plans is a mindstretcher for children.

Objectives:

- Identify variables in an experiment that are held constant and those that are manipulated.
- Given the results of an experiment, identify the responding variable.
- Construct an operational definition of an event so that the effect of a manipulated variable can be clearly identified.

Topic 13: Interpreting Results

Matrix-Correlation Chart emphasis:

- A-1 Belief in Myself
- A-4 Mental and Physical Well-Being
- C-2 Product and Service Selection
- E-1 Concern for People
- E-2 Constructive Adjustment

Related Science Content/Process Chart emphasis:

Process: measuring, communicating, predicting, inferring, constructing operational definitions, interpreting data, formulating questions
Content: physical sciences, mathematical sciences, life sciences

Module

Your World Around You

Playing motion games and reading sports stories are ways children can become acquainted with position and change-in-position problems. Observing bike wheels and phonographs extend these activities into descriptions of velocity.

Objectives:

- Describe observed changes in the position of objects relative to a specified position.
- State and apply a rule that the speed of an object is the distance moved per unit of time.
- Describe and demonstrate how to measure the rate of revolution of a revolving object in revolutions per unit of time.
- Distinguish between revolution and linear speed.
- Construct vectors to represent forces and changes in motion related to force.
- Identify forces causing motion.

Module

Repeating Events, A Pattern

When events occur with a regular frequency, many times patterns are observable. Using animals in mazes, field of vision through tubes, and pin-hole cameras, children have the challenge both to collect information and to search for regularities in their data.

Objectives:

- Identify and name a relationship between two variables.
- Construct a graph to show the relationship between two variables.
- Construct predictions based on graphs.

Module

Rules for Spinning

There are some interesting common features of circles. These features are important to measuring a circle or measuring its speed. Investigations involving balanced and unbalanced forces help children in their continuing search for patterns or rules by which their world can be interpreted.

Objectives:

- Construct a force diagram to illustrate balanced and unbalanced forces acting on objects which may be moving or which may be at rest.
- Show that the greater the unbalanced force, the greater the change in the body or object.
- Demonstrate the use of the standard metric unit for measuring forces — newton.
- Apply the rule for measuring the distance a wheel rolls given the circumference.
- Apply the rule of circumference and diameter of a circle.

Module

Patterns in Electricity

Lighting a flashlight bulb with a battery and a length of wire is a way to help children gain insight into many thinking skills. Activities involving circuits and picture definitions help children develop concepts in the patterns of behavior of electricity.

Objectives:

- Construct an electric circuit.
- Distinguish between an operational definition and a non-operationally stated definition.
- Construct an operational definition.
- Construct an inference or a hypothesis given a set of observations.
- Construct predicted events based on inferred or hypothesized patterns.
- Identify observations which support or do not support an inference or hypothesis.

Topic 14: Testing Explanations

Matrix-Correlation Chart emphasis:

A-1 Belief in Myself
A-2 Organization of Thought Processes

Science Content/Process Chart emphasis:

Processes: constructing operational definitions, defining variables, interpreting data, formulating questions
Content: life sciences, mathematical sciences

Module

How to Learn

Forming higher order thinking skills is important for children, but the development of these skills is not usually specifically addressed by the school. In this module, students are involved in learning experiments in which they identify which variables affect the development of their thinking achievements.

Objectives:

- Identify and name three types of variables in an experiment (constant, manipulated, and responding).
- Demonstrate a test of a hypothesis.
- Describe a pattern found in data.
- Construct a hypothesis based on patterns of data.

Module

Plants Alive

Plants represent a vehicle for experimentation in which many growing conditions can be systematically varied. Planning and conducting experiments with plants is an opportunity for children to demonstrate their creativity.

Objectives:

- Demonstrate a test of the effect of a manipulated variable.
- Identify data which support or do not support a hypothesis.
- Construct a revision of a hypothesis based on new data.
- Construct an operational definition.

Topic 15: Emphasizing the Tentativeness of Conclusions and Probability

Science Content/Process Chart emphasis:

Interpreting Data—Life Sciences, Physical Sciences
Formulating Questions—Life Sciences
Experimenting—Life Sciences

The nature of this topic is deliberately quite broad to allow the student some choice in designing and performing activities that emphasize "tentativeness of conclusions and probability." An example might be predicting the probability of precipitation within a 12-hour period after studying weather maps taken from the daily newspaper, and repeating this process of prediction several times. The number and duration of these activities is limited only by the creativity of the students and teachers.

COMPONENT TWO:
MATRIX CORRELATION CHART
(Topics* may be used in any appropriate learning cell.)

WHAT PEOPLE DO

WHAT SCHOOLS DO

	—A— Living with Self	—B— Career Choices	—C— Consumer Choices	—D— Leisure Choices	—E— Living with Others (Culture)
1 Values, Attitudes, Aspirations	A-1 Belief in Myself 5,6,13,14	B-1 Commitment	C-1 Consideration of Consequences 3,7,15	D-1 Worthy Choice	E-1 Concern for People 7,13
2 Process Skills (Rational Thinking Skills)	A-2 Organization of Thought Processes 1,2,6,7,8, 9,10,14	B-2 Decision-Making	C-2 Product and Service Selection 10,13	D-2 Logical Decisions	E-2 Constructive Adjustment 5,6,10,13
3 Psychomotor (Manipulative Skills)	A-3 Competence in Handling Materials 4,8,11,12	B-3 Use of Basic Materials 1,6,8,9	C-3 Mechanical Aptness 4,8	D-3 Creative Application	E-3 Safe Practices 8,12
4 Knowledge	A-4 Mental and Physical Well-Being 5,6,10,13	B-4 Choice and Competence	C-4 Technical Application	D-4 Hobbies and Recreation 1	E-4 Interactions of Science Technology and Society

*Numbers refer to topics listed in the Elementary Science Framework. School personnel will want to add to these suggested topics to meet the interests and needs of local students. For Origin of Framework Matrix, see Appendix page 59.

COMPONENT THREE:
SCIENCE CONTENT/PROCESS CHART
(Topics* may be used in any appropriate learning cell.)

	CONTENT Life Science		Earth Science		Physical Science			Mathematical Science	
PROCESS	Plants	Animals	Rock & Minerals	Weather & Astronomy	Properties & Changes of Matter	Force & Motion	Magnetism & Electricity	Geometry	Graphing & Functions
Observing	1,2,3,7	1,2,3,5,7		7	1,2,7,8	8	7,10	1,7	8
Measuring	4,8,9	8,9	4	7	4,7,8,9,11	8,9,13		8	9
Classifying	6	6	6,12		6,12		10	6	9
Communicating	4,7,9	5,9	4,11	7	4,7	13		11	9,13
Predicting	12	14			12,13	10,13	10		10
Inferring	10,12	10			10		10,13		
Constructing Operational Definitions	14	11,12			12	11,13	12,13		13
Defining Variables	12,14	14			12	12			
Interpreting Data	15	13,14,15	12	15	12,13,15	13	12	11	14
Formulating Questions, Hypotheses, & Models	14	14,15			11,12	11	13		
Experimenting	15	15							

* Numbers refer to topics listed in the Elementary Science Framework. School personnel will want to add to these suggested topics to meet the interest and needs of local students.

MIDDLE SCHOOL SCIENCE FRAMEWORK
Grades 6-8

GRADE 6

Science education at Grade 6 should be regarded as vital to the student's development. The curiosity exhibited by adolescents should be fostered through asking them questions of how their world works. The majority of the inquiries can and should be answered through a laboratory or field investigation. These activities have the pedological advantage of heightening the students' interests, thereby promoting their efforts in related areas such as reading, mathematics, and social studies.

The science instruction offered at this level presents information from a variety of the areas of science; however, the depth of presentation should be carefully tailored to fit the interests, background, maturity, and educational needs of the students. It is important that each student achieve success.

Instructional material for the sixth grade may include investigations of such topics as native plants and animals, people's use of domestic animals (including pets), simple machines, friction, states of matter, heat, light, sound, electricity, and/or magnetism.

Sixth Grade science should be structured and sequenced to further develop the concepts, skills, and thought processes that will be useful to the student, both at present and in the future. Science at this level offers an opportunity to integrate science instruction with drug, career, environmental, and health education.

An alternative for schools who wish to widen the course offerings at this level is to offer courses in Grade 6 that are listed for Grades 7 and/or 8; however, these courses taken in Grade 6 are not to be counted toward satisfying the requirements of science instruction in Grades 7 and/or 8.

GRADES 7-8

In contemporary curricula at the secondary school level, Grades 7-12, science instruction is presented in a manner designed to stimulate the students' interest in the nature of their surroundings. The types of questions that students ask (How?, What?, When?, and Why?) are posed by scientists. Through a broad array of investigative experiences, a personal knowledge base is acquired by the student from which the "answers" to these types of questions can be drawn.

Ideally, each concept is introduced through a teacher-led discussion. During this discussion, the problem is carefully explained and defined to ensure that all students understand "what" is being investigated. Also, this is an appropriate time to discuss the method of investigation that should be used, suggestions of how the equipment should be set up, the kinds of observations that might be made, the type of data that should be collected, and the safety practices that will be followed.

The second stage of the learning sequence is the student laboratory/field activity. In this phase, the laboratory or field setting is used to make observations and to collect data. This stage is designed to foster student interest in the topic and to provide multiple inputs to the students' physical senses. The laboratory/field experience is followed by a discussion and/or analysis of the observations. During this latter phase, inferences concerning the "How?, What?, Where?, When?, and Why?" questions are made.

One of the goals of each learning activity sequence (pre-laboratory discussion, investigative experience, post-laboratory discussion) is to be sufficiently interest-provoking to cause the student to want to know more about the topic than the sequence alone provides.

In recognition of the diversity of student capabilities and the variety of student interests represented within the state, an alternative level of instruction has been introduced in the science program. This level, with each course labeled Applied is intended to meet more closely the educational needs of students who intend to pursue careers other than science related ones. The Applied course sequence gives instruction in approximately the same concepts as does the academically-oriented courses; however, the mathematical analysis of the data is not so formal nor detailed.

REQUIREMENTS

Courses listed for Grades 7 and 8 require a minimum of 65 clock hours each.

During Grades 7 and 8, each student shall complete a minimum of two semester courses in science. Each of the described courses is to be laboratory oriented (i.e., a minimum of 40 percent of the instructional time is devoted to student laboratory/field activities, exclusive of teacher demonstrations).

Administrators of each school district are urged to make available as many courses as possible to meet the science education needs of their students.

COURSES

LIFE SCIENCE

The courses in life science present general exploratory learning experiences in the nature of living things, including the interrelationships of organisms with their environment. These courses expand and further refine the basic biological concepts that were introduced in the elementary grades. The courses are laboratory/field oriented (a minimum of 40 percent of instructional time is devoted to laboratory/field activities). The activities should be presented as a mixture of confirmatory exercises and inquiries into nature.

The laboratory phase of the learning activities in these courses stresses accurate observations, data collection and analysis (to the depth appropriate for the students), and the manipulation of laboratory equipment.

The life science courses are designed to aid the student in:

- developing positive attitudes toward science
- presenting the applications of scientific knowledge in everyday living
- understanding the fundamentals of the life processes

DIVERSITY OF PLANTS & ANIMALS — Grade Placement: 7-8
Prerequisite: None

An introduction to the nature of life, life cycles, and energy flows and to the diversity of organisms in their environment. Topics of study include: vertebrate and invertebrate animals; viruses, bacteria, protists, fungi, mosses, ferns, and seed plants.

BIOLOGICAL PROCESSES
Prerequisite: None

Grade Placement: 7-8

A study of the biological processes of living things. The course includes exploratory studies of the cell, tissues, organs, systems, the stimulus—response mechanism, the elements of proper nutrition, body systems, signals of malfunction, and myths and superstitions of health practices.

SURVEY OF LIFE SCIENCES
Prerequisite: None

Grade Placement: 7-8

Laboratory/field activities and the presentation of the theories of the introductory concepts of living things. Topics of study include: human systems, plants and animals, and needs of living things in their environments.

APPLIED LIFE SCIENCE

Applied life science courses offer students general exploratory experiences and activities in the fundamental concepts of the biological sciences. These courses are similar to the life science courses in that both:

- expand and refine the biological concepts that were introduced in the elementary grades
- aid the student in reading and interpreting graphic information
- provide the student meaningful laboratory/field activities

These courses give differentiated instruction specifically designed to aid students in understanding the usefulness of science. This differentiation is accomplished by adding emphasis to:

- the applications of scientific concepts and principles in everyday life
- the development of laboratory manipulative skills
- the development of a knowledge base of the fundamentals of the life processes

LIVING THINGS AND THEIR ENVIRONMENT
Prerequisite: None

Grade Placement: 7-8

The study of life characteristics of an organism and its needs with emphasis on the interdependence of organisms and their surroundings. Extensive utilization of nature trails, nature areas, and/or outdoor school sites is an integral portion of the course.

APPLICATION OF THE LIFE SCIENCES
Prerequisite: None

Grade Placement: 7-8

The study of the applications of the life sciences. The study includes a presentation of the applications of medical and folk health practices, body needs and functions, and disease and symptoms of body malfunctions.

PEOPLE'S ENVIRONMENT **Grade Placement: 7-8**
Prerequisite: None

Laboratory/field investigations of the interrelationships of people with the environment. Emphasis is placed on the effects of pollutants on living things, accepted conservation practices, and proper management of our resources.

EARTH SCIENCE

The courses in earth science offer students general exploratory experiences in the fundamental concepts of geology, oceanography, meteorology, and/or astronomy. These courses expand and refine the concepts of the sciences that were introduced in the elementary grades and present additional "facts" and concepts that will aid in building a background knowledge base for the student.

The laboratory/field phase of the learning activities in these courses is to be presented as a combination of inquiry and confirmatory exercises.

The earth science courses are planned to enable the student to:

- observe earth phenomena that are encountered in the local environment
- read and interpret graphic information
- construct maps and models to explain natural phenomena
- develop and refine laboratory skills

GEOLOGY AND OCEANOGRAPHY **Grade Placement: 7-8**
Prerequisite: None

A study of rocks and minerals, composition of soils, and the formation, movement, and resulting topography and structure of our "solid earth." The course includes a presentation of geologic changes from both a historical and a physical viewpoint with emphasis on the wise use of our nonrenewable resources.

Included in the course is a study of the oceans including the size, shape, and theories of the origin of the ocean basins. Investigations of plant and animal life in the ocean, tidal currents, mineral contents, and the effects of pollution on life in the ocean are conducted.

WEATHER AND ASTRONOMY **Grade Placement: 7-8**
Prerequisite: None

Topics on the gaseous shell of the earth, its composition, structure, and movement relative to the surface of the earth. This phase of the course deals specifically with the composition and properties of our atmosphere, solar and terrestrial radiation and heat transfer, the hydrological cycle, factors that determine our climate, and the nature of air pollutants and their effects on our ecosystem.

Additional topics within the course are a study of the earth in space, the structure of our solar system, and the theories of the origin of our solar system. This study includes the earth's movements and those of our moon and other satellites, with emphasis given to the topics "astronomy as a profession and a hobby" and "the earth as a space ship."

SURVEY OF EARTH SCIENCE — Grade Placement: 7-8
Prerequisite: None

Selected fundamental concepts of introductory geology, oceanography, meteorology, and astronomy. Each concept is introduced as an inquiry into nature through a laboratory or field experience. The activity should be supported by the presentations, clarifications, and discussions of the theories of the concept being presented. Topics investigated should include: the formation, movements, and topography of the planet; rocks and minerals; environments and animals of past eras; origin and shape of the oceanic basins; circulation of ocean waters; ocean currents; the water cycle; composition of and circulation in our atmosphere; climate-determining factors; the effects of polutants; the solar system; the earth's movements and their effects; and the earth as a space ship.

APPLIED EARTH SCIENCE

Applied earth science courses offer students general exploratory experiences and activities in the fundamental concepts of astronomy, oceanography, meteorology, and geology.

These courses are similar to the earth science courses in that both:

- expand and refine the concepts of earth science that were introduced in the elementary grades
- aid in building a student's background knowledge base
- aid the student in reading and interpreting graphic information
- offer the student the opportunity to conduct laboratory/field activities

These courses give differentiated instruction designed for student understanding of the uses of science. The differentiation is accomplished by:

- emphasizing practical applications of the scientific concepts and principles in everyday life
- minimizing the mathematical computations used in analysis of data
- stressing the development of manipulative skills

MINERALS AND LAPIDARY — Grade Placement: 7-8
Prerequisite: None

The study and identification of rocks and minerals in their natural surroundings and through laboratory procedures. Laboratory studies include the shaping and polishing of materials for display and/or adornment.

THE EARTH: ITS HISTORY AND ITS NEIGHBORS Grade Placement: 7-8
Prerequisite: None

Investigations of theories of the origin of the earth and its astronomical neighbors. Additional topics presented include: the structure, composition and movements of our earth; rocks and minerals; the hydrological cycle and its effects; the solar system's structure and movements; and astronomy as a hobby and/or profession. Studies are to be conducted on the succession of animal and plant life, placing emphasis on the environments of past eras.

ENERGY Grade Placement: 7-8
Prerequisite: None

The study of energy sources and their local utilization. Investigations are conducted as to the types of energy used locally with comparisons made of the cost/unit from each source. Studies are conducted on alternative energy sources for local use with emphasis on methods of conserving energy.

PHYSICAL SCIENCE

The physical science courses offer students exploratory experiences in the fundamental concepts of chemistry and physics. The courses expand and refine the concepts of these sciences that were introduced in the elementary grades. The courses are identical with those listed for physical science, Grades 9-12.

The laboratory phase of each learning activity is to be presented using a combination of inquiry and confirmatory activities. Each experience stresses:

- **observations, data collection and analysis (to a depth appropriate for the students)**
- **the manipulation of laboratory apparatus**

The physical science courses are planned to assist the students in:

- **developing an understanding of the phenomena that occur in the physical world**
- **developing skill in verbal and graphical presentation of observations and inferences**

INTRODUCTION TO PHYSICS Grade Placement: 7-8
Prerequisite: None

An introduction to laboratory procedures and measurements used in the physical sciences. Topics presented include the metric system, analysis of data, forces, motion, machines, area, volume, mass, displacement, density, velocity, and acceleration. The course presents an introduction to the particular nature of matter and heat and an introduction to wave motion, physical behaviors and properties of gases, liquids, solids, temperature, sound, electricity, magnetism, and light.

INTRODUCTION TO CHEMISTRY — Grade Placement: 7-8
Prerequisite: None

An overview of activities involving the chemical nature of solids, liquids, and gases. Other topics included in this study are an introduction to atomic structure, chemical formulas, and chemical equations; and an introduction to the chemical nature of elements, mixtures, compounds, acids, and bases. The course presents opportunities to correlate hypotheses with observations of the chemical phenomena of neutralization, of precipitation, and of gas evaluation and color change of ph indicators.

SURVEY OF PHYSICAL SCIENCE — Grade Placement: 7-8
Prerequisite: None

A survey of laboratory procedures and measurements used in the physical sciences. Topics presented include the metric system, forces, motion, machines, mass density, properties of matter (both physical and chemical), temperature, heat, electricity, and light. Other topics include chemical formulas and equations, neutralization, and color change of ph indicators. The course presents opportunities for guided student laboratory investigations of the fundamental concepts of chemistry and physics.

APPLIED PHYSICAL SCIENCE

Applied physical science courses offer students general exploratory experiences and activities in the fundamental concepts of chemistry and physics. This sequence of courses is identical to the applied physical science courses for Grades 9-12 in that they:

- stress observation and data collection and analysis
- expand and refine the concepts of these sciences that were introduced in the elementary grades
- aid in building a student's background knowledge base
- offer the student the opportunity to conduct laboratory activities

These courses give differentiated instruction designed for student understanding of the uses of science. The differentiation is accomplished by:

- emphasizing the practical applications of the scientific concepts and principles in everyday life
- stressing the development and practice of manipulative skills
- minimizing the mathematical computations used in analysis of data

FUNDAMENTALS OF PHYSICS — Grade Placement: 7-8
Prerequisite: None

Introductory laboratory investigations of the topics: the metric system, force, motion, simple machines, area, volume, mass, mass-volume relationships, displacement, velocity, and acceleration. Other topics include the relationships of energy and matter; properties of solids, liquids, and gases; behavior of electricity, magnetism, heat, sound, and light. Emphasis should be placed on the practical applications of knowledge of these topics.

FUNDAMENTALS OF CHEMISTRY **Grade Placement: 7-8**
Prerequisite: None

Laboratory activities designed to investigate the chemical properties of elements, mixtures, compounds, acids, and bases. Other topics include the chemical phenomena of neutralization, precipitation, gas evolution, and color change of ph indicators. Emphasis is to be placed on the practical use of the knowledge of these topics.

APPLICATIONS OF PHYSICAL SCIENCE **Grade Placement: 7-8**
Prerequisite: None

A survey of the applications of the concepts of chemistry and physics. Student laboratory investigations of topics include the metric system, force, motion, machines, mass density, chemical and physical properties of matter, temperature, heat, electricity, and light. Other topics include: the chemistry of foods; the use of solvents, detergents, fertilizers; simple and compound machines; and the use of concepts of both chemistry and physics in photography.

HIGH SCHOOL SCIENCE FRAMEWORK
Grades 9-12

INTRODUCTION

The science program at the senior high school retains the student as its central focus. This is an activity-oriented program (a minimum of 40 percent of instructional time is devoted to laboratory/field investigations by students, exclusive of all demonstrations) in which each concept is presented in a planned, three-phase learning sequence. In the first phase, a concept is introduced through a teacher-led discussion of the phenomenon to be investigated, of how the equipment should be set up, of the student observations that should be made, of the data that should be collected, and of the safety practices that will be followed.

The second phase of the learning sequence is the student laboratory/field investigation. The investigation is designed to capture and foster student interest, to be safe for students, and to ensure the student achieves success in the performance of the activity.

The third phase of the sequence is the post laboratory discussion. During this discussion, data and analysis of data are further clarified. The meaning and implications of the analysis are discussed with the students.

One of the goals of each learning sequence (pre-laboratory discussions, investigative experiences, post-laboratory discussion) is to cause the student to want to know more about the topic than the learning sequence alone provides.

The traditional academically-oriented sequence of courses (Physical Science, Biology I, Chemistry I, Physics I, Anatomy and Physiology, Geology, Meteorology, Astronomy, Marine Science, and Environmental Science) are aimed toward the development of thought processes and manipulative techniques and the building of a background of knowledge on which the student can base further academic study in science.

As in junior high school, an applied level of courses is offered. Applied courses allow exploratory investigations to be specifically designed to meet more closely the educational needs of those students who intend to pursue a career other than a science-related one. These courses present approximately the same concepts as the traditional courses; however, they stress the applications of the concepts and de-emphasize the mathematical exercises. The mathematical problems presented in these courses retain the necessity of reasoning from a scientific principle in order to achieve the desired outcome.

A third level of courses is included in this science instructional program. These courses are entitled *Science Area II* and are designed to meet the educational needs of those students aspiring toward a science related career. More commonly, these courses (Biology II, Chemistry II, Physics II) are second year, academically-oriented courses. In addition, the studies offer the students an opportunity to conduct team and/or individual research activities.

REQUIREMENTS FOR GRADUATION

Prior to graduation from high school (Grades 9-12), each student must receive credit in four semester courses in science. These courses can be in any area(s) of science; however, counselors, teachers, and other advisors should encourage students to take the science courses that will meet their individual educational needs whether they are college preparatory, career-oriented, and/or vocationally oriented.

The science requirement of four semester units may be fulfilled in one of the following ways:

- Completion of four semester units of science taught by the laboratory method selected from the science courses for Grades 9-12.

- Completion of 130 clock hours of science taught by the laboratory method as described in the requirements for Grades 7 and 8, and two semester units of science taught by the laboratory method from the science courses for Grades 9-12. The work in Grades 7 and 8 is not to be counted as part of the 36 basic high school semester units required for graduation.

MINIMUM OFFERINGS BY A SCHOOL DISTRICT

Each accredited secondary school (Grades 7-12) shall make available to students six years of science including Biology, Chemistry, and Physics.

COURSES

PHYSICAL SCIENCE

The course titles are identical with the physical science courses offered in Grades 7-8. (See pages 28-30.) A student who successfully completes the courses in Grades 7 and/or 8 should not repeat the courses in Grades 9-12.

BIOLOGY I

Biology I semester courses offer students general exploratory experiences and activities in the fundamental concepts of life (i.e., the origin, structure, development, and reproduction of living organisms). These courses expand and refine the biological concepts that were introduced in the elementary and the junior high school and present additional "facts" and concepts that will aid in building a background knowledge base for the student. The laboratory/field phase of each learning sequence is presented in a combination of inquiry and confirmatory activities. Each experience stresses accurate observations, data collection and analysis, and manipulation of laboratory/field equipment.

The Biology I courses are designed to assist students in developing a mature understanding of:

- the investigative methods and techniques practiced by biologists in their work

- the relationships of organisms to their environment

- the application of biological principles and concepts in everyday life experiences

CELLULAR BIOLOGY
Grade Placement: 9-12
Prerequisite: None

Investigations of the structure and functions of cells. This study includes energy flows, protein synthesis, enzymes, hormones, and vitamins. Also, replication of cells and basic concept of inheritance are included.

PLANT AND ANIMAL SURVEY
Grade Placement: 9-12
Prerequisite: None

Exploratory activities of plants and animals. This study includes a presentation of cells, the organization and the progressive complexity of organisms, and their means of locomotion, reproduction, digestion, and circulation. Additional topics are conditions needed for survival of an organism and a study of the economic importance of plants and animals.

LIVING SYSTEMS
Grade Placement: 9-12
Prerequisite: None

Investigations of the biological systems. This study includes circulatory, respiratory, reproductive, and digestive systems and the mechanisms and controls of these systems.

APPLIED BIOLOGY

Semester courses in applied biology offer students general exploratory experiences and activities in the fundamental concepts of life (i.e., the origin, structure, development, and reproduction of living organisms). The concepts presented in these courses may be reinforced through their use in a biologically-oriented facility under the supervision of properly-trained personnel.
This sequence of courses is similar to the Biology I course in that both:

- stress accurate observations and data collection and analysis
- expand and refine the concepts of these sciences that were introduced in the elementary and junior high grades
- aid in building a student background knowledge base
- aid the student in reading and interpreting graphic information
- offer the student the opportunity to conduct laboratory/field activities

These courses give differientiated instruction designed for students whose aspirations involve a career other than a science related one. The differentiation is accomplished by:

- emphasizing practical applications of the scientific concepts and principles in everyday life
- stressing the development of manipulative skills

PLANTS AND/OR ANIMALS — Grade Placement: 9-12
Prerequisite: None

Laboratory/field investigations of plants and animals. This study emphasizes the progressive complexity of living structures, means of reproduction, condition for survival, and economic importance.

NUTRITION AND HEALTH PRACTICES — Grade Placement: 9-12
Prerequisite: None

Study of proper health care practices. This study includes functions of organs and systems, elements of proper nutrition, symptoms of body malfunctions, myths, superstitions, and folk health remedies.

APPLICATIONS OF BIOLOGY — Grade Placement: 9-12
Prerequisite: None

Laboratory/field exploratory activities of the career applications of the biological sciences. Emphasis is placed on the cause-effect relationships that operate within our ecosystem. Students will be offered the opportunity of exploring selected careers that use biological concepts. (Examples: horticulture, animal husbandry, and health care.)

BIOLOGY II

Biology II semester courses offer students advanced level experiences in the concepts of biology. Laboratory activities are presented as a combination of inquiry and confirmatory exercises. Advanced level laboratory techniques are developed to further the student's ability to pursue a biological science related career. These concepts may be reinforced through their applications in a biologically-oriented facility under the supervision of properly-trained personnel. These courses are designed to aid the student in:

- obtaining advanced collegiate placement in the biological sciences
- applying revelant principles and concepts to both familiar and unfamiliar situations
- practicing appropriate investigative methods and techniques used by professional scientists

MICROBIOLOGY AND BIOCHEMISTRY — Grade Placement: 11-12
Prerequisite: 2 semesters of biology;
2 semester courses of chemistry (may be taken concurrently)

Advanced level laboratory investigation of chemical reactions that occur in organisms. These investigations should include action of enyzmes, Kreb cycle, protein synthesis, cell replication, and specialization.

ORGANISMS AND THEIR ENVIRONMENT — Grade Placement: 11-12
Prerequisite: 2 semesters of biology;
2 semester courses of chemistry (may be taken concurrently)

Advanced techniques of investigating the biological systems of plants and animals, their economic importance, and the factors that influence their development.

SPECIAL TOPICS — Grade Placement: 11-12
Prerequisite: 2 semesters of biology;
2 semester courses of chemistry (may be taken concurrently)

Advanced laboratory/field techniques and presentation of the theory of selected biological topics.

PHYSIOLOGY AND ANATOMY

Physiology and anatomy semester courses offer students general exploratory and advanced activities in the structures and functions of the components of the human body. Extensive use of illustrative anatomical models and charts are to be made in the learning activities. This knowledge may be reinforced through applications in a medical facility under the supervision of properly-trained personnel. These courses are designed to aid in building a knowledge base for those students who wish to pursue a medically related career/profession.

The anatomy and physiology courses are designed to assist students in:

- practicing the methods and techniques used by professional scientists in medical investigations
- building a mature understanding of the relationship of the structure of a component of the human body to the physiological function of that component
- acquiring a realization of the interrelationships of the body systems

SURVEY OF PHYSIOLOGY AND ANATOMY—A — Grade Placement: 10-12
Prerequisite: None

A laboratory investigation of organisms. The topics presented include body systems (structure, function, and regulating mechanisms), cell specialization, and gross anatomy.

SURVEY OF PHYSIOLOGY AND ANATOMY—B — Grade Placement: 10-12
Prerequisite: None

Continuation of the course Survey of Physiology—A. Topics should be chosen to further broaden the student's background knowledge of the applications of physiology.

COMPARATIVE ANATOMY — Grade Placement: 10-12
Prerequisite: 2 semesters of biology

A laboratory oriented comparative study of selected organisms.

CHEMISTRY I

Chemistry I semester courses offer students general exploratory experiences and activities in the concepts of chemistry. They expand and refine the chemical concepts introduced in the earlier grades. Also, they present additional facts and concepts to aid in building the student's background knowledge base.

The laboratory phase of each learning activity sequence is to be presented as a combination of inquiry and confirmatory activities. Each experience is designed to be sufficiently interest provoking to cause the student to want to know more about the topic than the experience provides.

The Chemistry I courses are designed to assist the student in:

- accurately observing chemical phenomena that are encountered
- tabulating, analyzing, and displaying observed data
- reading and interpreting graphic information
- applying relevant chemical principles and concepts in explaining phenomena
- practicing laboratory manipulative skills

PROPERTIES OF MATTER, ATOMIC STRUCTURE AND SOLUTIONS

Grade Placement: 9-12

Prerequisite: None

A laboratory investigative approach to the study of the properties of elements, mixtures, and compounds. Investigations of stoichiometric relationships and of the periodicity of the elements are conducted. Other topics include: the relationships of atomic spectra to atomic structure; chemical bonding; solutions; chemical reactions; and acids, bases, ph, and solution equilibria.

ELECTRO-CHEMISTRY, ORGANIC CHEMISTRY, AND QUALITATIVE ANALYSIS

Grade Placement: 9-12

Prerequisite: None

A laboratory approach to the study of Faraday's Laws and oxidation-reduction reactions. Student investigations of organic chemical reactions relating molecular structure and the reactivities of various functional groups are included in this study. The nomenclature of organic chemicals (both International Union of Pure and Applied Chemistry and common systems) is emphasized.

ANALYSIS

Grade Placement: 9-12

Prerequisite: None

Presentations of theories and laboratory techniques used in chemical analysis.

APPLIED CHEMISTRY

Semester courses in applied chemistry offer students general exploratory experiences and activities in the concepts of the chemical interactions of matter. This series of courses is similar to the Chemistry I courses in that both:

- stress accurate observations and data collection and analysis
- expand and refine the chemical concepts that were introduced in the earlier grades
- aid in building a student's background knowledge base
- assist in reading and interpreting graphic information
- offer the student the opportunity to conduct laboratory investigations

The courses offer differentiated instruction designed for students whose aspirations involve a career other than a science related one. The differentiation is accomplished by:

- emphasizing practical applications of scientific concepts and principles in everyday life
- minimizing the mathematical computations used in the analysis of data
- stressing the development of laboratory manipulative skills

The concepts presented can be reinforced through their application in a chemically-oriented facility, under the supervision of properly-trained personnel.

APPLICATION OF CHEMISTRY—A — Grade Placement: 9-12
Prerequisite: None

Laboratory investigations of the chemical reactions involved in water purification, horticulture, and/or photography. Additional topics of the applications of chemistry, should be drawn from materials on Chemistry of Medicine, Combustion, Kitchen Chemistry, Chemistry of the Automobile, Atmospheric Chemistry, the Chemistry of Cosmetics, the Chemistry of the Blood, Environmental Chemistry, Solar Chemistry, Chemistry of the Sea, Nuclear Chemistry, Geo-Chemistry, Textiles and Fabrics, Analytical Processing, and/or Industrial Processes.

APPLICATIONS OF CHEMISTRY—B — Grade Placement: 9-12
Prerequisite: None

Continuation of the course "Applications of Chemistry—A." Topics should be chosen to further broaden the student's background knowledge of the applications of chemistry.

APPLICATIONS OF CHEMISTRY—C — Grade Placement: 9-12
Prerequisite: None

Continuation of the course "Applications of Chemistry—B."

CHEMISTRY II

Chemistry II semester courses offer students advanced-level and enrichment experiences in concepts involving chemical changes of matter. Laboratory activities and investigations are presented in the spirit of inquiry and research. Advanced-level laboratory techniques are developed to further the student's ability to pursue a chemical science related career. The concepts presented may be reinforced through their application in a chemically-oriented facility, under the supervision of properly-trained personnel. These courses are designed to aid the student in:

- obtaining advanced collegiate placement in the chemical sciences
- applying revelent principles and concepts to both familiar and unfamiliar situations
- practicing appropriate research methods and techniques used by professional scientists

ATOMIC THEORY, PROPERTIES OF MATTER, AND CHEMICAL REACTIONS

Grade Placement: 11-12

Prerequisite: 2 semesters of chemistry and
2 semesters of physics (may be taken concurrently)

Advanced investigations and presentations of theory of atomic spectra, bond strength, reactivity series, determination of molecular mass, and techniques used in laboratory investigations of the chemical properties of gases, liquids, and solids. Other topics included in this course are concentration of solutions, acid/base theory and indicators, and oxidation-reduction reactions.

KINETICS AND EQUILIBRIA

Grade Placement: 11-12

Prerequisite: 2 semesters of chemistry and
2 semesters of physics (may be taken concurrently)

Laboratory investigations of reaction rates, equilibrium constants, and reaction order. The effects of pH on equilibria, on buffer systems, and on solubility product constants are included as topics of study in this course.

SPECIAL TOPICS IN CHEMISTRY

Grade Placement: 11-12

Prerequisite: 2 semesters of chemistry and
2 semesters of physics (may be taken concurrently)

Advanced laboratory techniques and the presentation of the theories of selected chemical topics.

PHYSICS I

Physics I semester courses offer students general exploratory experiences and activities in the concepts of the physical interactions of matter. These courses expand and refine the physical concepts introduced in earlier grades and present additional facts and concepts to aid in building the students' background knowledge base.

The laboratory phase of each learning sequence is to be presented as a combination of inquiry and confirmatory activities. Each experience stresses accurate observations, data collection and analysis, and manipulation of laboratory equipment.

The Physics I courses are designed to assist the student in:

- making observations of nature and drawing logical inferences from these observations
- explaining the reasoning used in describing a particular physical occurrence
- realizing that physical laws are useful only if they can explain a multitude of familiar and unfamiliar phenomena
- assessing the uncertainty inherent in measurements and determining the effects of these uncertainties
- designing and performing laboratory investigations and interpreting the resulting data

MECHANICS, HEAT, AND SOUND — Grade Placement: 9-12
Prerequisite: None

Laboratory investigations and presentations of theories of velocity, acceleration, and harmonic and linear motion. The course includes as topics of study: forces, momentum, energy, work, power, conservation of momentum, inertia, collisions, and thermal effects on matter. Additional topics of study are heat of fusion, heat of vaporization, kinetic theory of matter, wave motion, sound, and the Doppler effect.

LIGHT, ELECTRICITY, MAGNETISM AND NUCLEAR PHYSICS — Grade Placement: 9-12
Prerequisite: None

Laboratory investigations and study of theory of the fundamentals of optics, electricity, and magnetism. The theory and laboratory experiments of electronic devices and electric fields is included in this course. Additional topics studied in this course are atomic structure, spectra of elements, isotopes, photoelectric effect, the Bohr atom, and the Quantum atom, X rays, relativity, radioactive decay, nuclear disintegrations, accelerators, fission, fusion, nuclear reactors, cosmic rays, and elementary particles.

ELECTRONICS — Grade Placement: 9-12
Prerequisite: None

Presentation of the theories and laboratory investigations of electronic devices. Topics of study include charge, current, potential, Ohm's and Kirchhoff's Laws, "T" and "π" networks, resistance, inductance, capacitance, RC and L/R time constants, and resonance. Additional topics of study included in the course are vacuum tubes, semiconductor diodes, transistors, and integrated circuits.

APPLIED PHYSICS

Semester courses in applied physics offer students general exploratory experiences and activities in the concepts of the physical interactions of matter. These courses are similar to those in physics in that both:

- stress accurate observations and data collection and analysis
- expand and refine the physical concepts that were introduced in earlier grades
- aid in building a student background knowledge base
- emphasize reading and interpreting graphic information
- offer the student the opportunity to conduct laboratory investigations

The courses give differentiated instruction designed for students whose aspirations involve a career other than a science related one. The differentiation is accomplished by:

- emphasizing practical applications of scientific concepts and principles in everyday life
- minimizing the mathematical computations used in analyzing the data
- stressing the development of manipulative skills

APPLICATIONS OF PHYSICS—A

Grade Placement: 9-12

Prerequisite: None

Laboratory investigations of the applications of physical reactions. Topics are drawn from materials such as the automobile ignition system, basic machines, behavior of gases, climatizing the home, color, electronics as a hobby, geophysics, ballistics, light, model rocketry, nuclear energy, photography, physics of communication, physics of sports, radio, physics of toys, radioactivity, and/or stereo sound.

APPLICATIONS OF PHYSICS—B

Grade Placement 9-12

Prerequisite: None

Continuation of the course "Applications of Physics—A." Topics should be chosen to further broaden the student's background knowledge of the applications of physics.

APPLICATIONS OF PHYSICS—C

Grade Placement: 9-12

Prerequisite: None

Continuation of the course "Application of Physics—B."

PHYSICS II

Physics II semester courses offer students advanced-level and enrichment experiences in the physical interactions of matter. They expand and refine the physical concepts introduced in the earlier grades. Further, the courses provide the student a more mature presentation of physics content and laboratory investigation of physical phenomena. The concepts presented in these courses may be reinforced through their applications in a physics/engineering-oriented facility, under the supervision of properly-trained personnel.

The laboratory program should be the students' primary source of information. This phase of instruction should be approached in the form of inquiring into the topics explored; however, the inquiries should be strongly supported through the solution of relevant problems.

The physics courses are designed to aid the student in:

- developing advanced laboratory skills that will aid in the pursuit of a physics related career
- obtaining advanced collegiate placement in the physical sciences
- applying relevant principles and concepts to both familiar and unfamiliar situations

MECHANICS AND THERMODYNAMICS — Grade Placement: 11-12
Prerequisite: 2 semesters of physics and
2 semesters of chemistry (may be taken concurrently)

Advanced laboratory activities and presentations of the theory of motion in one dimension of motion in a plane and of rotational and oscillatory motion. This course includes the topics: conservation laws, fluids, wave phenomena, the laws of thermodynamics, and the kinetic theory.

ELECTRICITY, MAGNETISM, AND ELECTRONICS — Grade Placement: 11-12
Prerequisite: 2 semesters of physics and
2 semesters of chemistry (may be taken concurrently)

Advanced laboratory activities and presentations of the theories of electricity and magnetism. Topics of instruction include charge (both static and in motion), circuit components and circuits, fields, and meters.

SPECIAL TOPICS IN PHYSICS — Grade Placement: 11-12
Prerequisite: 2 semesters of physics and
2 semesters of chemistry (may be taken concurrently)

Advanced laboratory activities and presentations of theories of selected topics in physics.

GEOLOGY

Geology semester courses offer students general exploratory experiences and activities in the concepts of the composition, structure, and history of the earth. Geology differs from other sciences in that it is primarily a field science; however, laboratory experiences are usually a necessary prerequisite for effective field work. The investigations of the earth are to present activities that will further expand and refine the earth science principles that were presented in the earlier grades. These investigations stress the applications of the principles of physics, chemistry, biology, and mathematics in the solution of earth science problems.

These courses are designed to assist the student in:

- making observations of phenomena, assumptions relevant to the observations, and inferences based on these observations.
- designing and performing experiments to test hypotheses
- realizing that concepts and laws are beneficial only to the degree in which they are useful in describing phenomena
- developing and refining laboratory skills

The recognition of geologic evidence requires an ability to observe and interpret natural phenomena. The study of Geology aids in building an understanding of our environment, how it was formed, and how it has been modified.

PHYSICAL AND HISTORICAL GEOLOGY

Grade Placement: 9-12

Prerequisite: None

A laboratory and field oriented study of minerals, rocks, stratigraphy (order and position of the layers in the crust), and geologic maps. The course includes the topics: physiography (features of the surface), topographic maps, and geomorphology (development of the crustal features) including the drifting of the continents.

Additional instructional topics should offer laboratory study of the development of the fossil sequence and the geologic time scale. The environments and living organisms through geologic time are included in this course.

GEMS AND MINERALS

Grade Placement: 9-12

Prerequisite: None

Laboratory study of the characteristics of rocks and minerals. Emphasis is placed on forming and polishing materials for display and/or adornment.

SPECIAL TOPICS

Grade Placement: 9-12

Prerequisite: None

Laboratory/field study and the presentation of the theories of selected topics in Geology.

METEOROLOGY

Meteorology semester courses present a study of the gases that surround the earth. These studies offer to students opportunities for general exploratory investigations of the composition, structure, and movements of the atmosphere.

Laboratory activities and field observations are to be the students' primary sources of information and should take the form of inquiries into nature. Problem solving is to be used as reinforcement for the concepts developed in the students' activities and field observations. Student observations are to be further clarified through class discussions and additional investigations. The activities and field experiences are to be chosen and directed in a manner to assure students' success in developing basic concepts in selected topics. Special emphasis is placed on building positive student attitudes toward the environment and on energy conservation.

The course is planned to assist students in:

- making observations of weather, assumptions about the observations, and inferences based on these observations
- designing and performing experiments to test inferences
- reading and interpreting maps and graphs
- developing and refining laboratory skills
- gaining an understanding of physical processes and natural laws underlying our changing weather patterns

MEASURING AND REPORTING THE WEATHER — Grade Placement: 9-12
Prerequisite: None

A study of weather instruments (what they measure and how they work). Other topics presented in this course include the methods of reporting the data, types of weather maps and the usual patterns of change, and methods used to formulate weather predictions.

CYCLES AND CIRCULATION OF THE ATMOSPHERE — Grade Placement: 9-12
Prerequisite: None

A study of the natural cycles of which the atmosphere is a component (water, carbon dioxide-oxygen, nitrogen, etc.). This course includes the theories and observation of the circulation in the atmosphere.

SPECIAL TOPICS — Grade Placement: 9-12
Prerequisite: None

Laboratory/field studies and the presentation of the theories of selected topics in meteorology.

ASTRONOMY

Astronomy semester courses present a study of the macroscopic universe and the conditions, properties, and motions of bodies in space. These courses give students opportunities to study and observe the order and arrangements of the planets, their satellites, and other astronomical bodies. Field and telescopic observations are to be the primary sources of information for the student. The observations must be strongly supported through presentations of theory.

Field trips to observatories and planetariums are helpful in these courses. The courses are designed to assist students to develop:

- a knowledge of the basic laws, theories, and terms of astronomy
- a skill in using a telescope and other scientific apparatus effectively
- ability to observe accurately, draw inferences from the observations, and form and test hypotheses
- a mature understanding of the relationships of people to the physical universe as a whole
- an attitude of open-mindedness, a willingness to suspend judgment, intellectual curiosity, freedom from prejudice and superstition, and an awareness of cause and effect relationships

THE SOLAR SYSTEM — Grade Placement: 9-12
Prerequisite: None

A study of the earth and its motions relative to our sun. Other topics included in this course are the earth's satellites and the other members of the solar system.

STAR CYCLES AND PRACTICAL ASTRONOMY — Grade Placement: 9-12
Prerequisite: None

An introductory study of stars and star systems. This study includes investigations and observations of the constellations, their positions and motions, and the use of star maps and guides in the location of stars and constellations.

SPECIAL TOPICS IN ASTRONOMY — Grade Placement: 9-12
Prerequisite: None

Laboratory/field studies and the presentation of the theories of selected topics in astronomy.

MARINE SCIENCE

Marine science semester courses present a study of the oceans including the physical boundaries; marine resources; chemistry, geology, and physics of the sea; and marine biology. Emphasis is placed on the conservation of marine resources and the preservation of the marine habitat.

This study of the oceans includes the applications of biology, chemistry, geology, physics, mathematics, meteorology, and engineering. The study of marine science presents selected problems arising in the fishing industry, offshore oil and gas production, navigation, control of beach erosion and deposition, weather forecasting, extraction of raw materials from the sea, marine construction, coastal sanitation, and fresh water supply.

The courses in marine science are laboratory/field-oriented courses in which each concept is introduced through student laboratory activities and/or by field experiences. These activities and field experiences are chosen and directed in a manner to asure the student's success in understanding the concept presented. The courses stress the operational understanding of the basic concepts in a few selected topics rather than a less thorough knowledge of numerous topics. Special emphasis should be placed on building the student's positive attitude toward his or her environment and self-image.

The courses in marine science are designed to assist the student in:

- developing positive attitudes toward the environment
- understanding the interrelationships of people and the environment
- applying skills and knowledge that were acquired in the study of other subject areas to the solution of practical problems
- acquiring a knowledge foundation on which to build a mature understanding of the various facets of marine science

PHYSICAL AND CHEMICAL OCEANOGRAPHY — Grade Placement: 9-12
Prerequisite: None

A study of the physical and chemical composition of the oceans. The course includes the topics: prevailing currents, waves, tides, circulation, and precipitation.

BIOLOGICAL OCEANOGRAPHY — Grade Placement: 9-12
Prerequisite: None

Investigations of marine organisms and their environments. This study emphasizes marine plants and animals, food web, oxygen cycle within ocean waters, and the adaptations of marine life to its environment.

SPECIAL TOPICS IN OCEANOGRAPHY — Grade Placement: 9-12
Prerequisite: None

Laboratory/field studies and the presentation of the theories of selected topics in marine science.

ENVIRONMENTAL SCIENCE

Environmental science semester courses present studies of the relationships of organisms to their habitats. These studies present people's use of the planet earth and its resources and resulting problems.

The courses in environmental science are laboratory/field oriented courses in which each concept is introduced through student laboratory activities and/or by field experiences. These activities and field experiences should be chosen and directed in a manner to assure the students' success in understanding the concept presented. The courses stress the operational understanding of the basic concepts in the selected topics rather than a less thorough knowledge of numerous topics. Special emphasis is placed on building the student's positive attitude toward his or her environment and self-image.

The primary aims of environmental science can be summarized through the topic of "the earth as a space ship." The effects of pollution of the water and air system are to be discussed. Conservation and "wise use" of nonrenewable resources should be investigated.

These courses are designed to enable the student to:

- develop a mature attitude of resource management
- develop an understanding of the interrelationship of organisms to their environment
- become a responsible citizen in dealing with environmental issues

ENERGY AND OUR ENVIRONMENT — Grade Placement: 9-12
Prerequisite: None

A study of the use of nuclear and fossil fuels for electric power generation. The study includes the utilization of solar, geothermal, wind, and hydroelectric energies and tides as alternative power sources.

ECOLOGY — Grade Placement: 9-12
Prerequisite: None

Laboratory/field study of the relationships of organisms to their ecosystems. Included in this study are alternative solutions to problems of overpopulation, pollution, and ecological balances.

SPECIAL TOPICS IN ENVIRONMENTAL SERVICE — Grade Placement: 9-12
Prerequisite: None

Laboratory/field studies and the presentation of the theories of selected topics in environmental science.

LABORATORY MANAGEMENT

Laboratory management semester courses offer students opportunities to observe the requirements for teaching science by the laboratory method. The students assist the teacher in the monitoring of student laboratory work. These courses are designed to aid the student to:

- develop a mature understanding of the science being studied
- develop a responsible attitude toward laboratory supplies and equipment
- become aware of and practice proper safety techniques
- develop proper laboratory techniques in the use, storage, and care of laboratory equipment

LABORATORY MANAGEMENT A

Grade Placement: 10-12

Prerequisite: None

A study of laboratory monitoring and management techniques. Selected students are introduced to the conditions, problems, and requirements of teaching science. Students help the teacher prepare and organize laboratory materials and aid the teacher in monitoring student laboratory work.

LABORATORY MANAGEMENT B

Grade Placement: 10-12

Prerequisite: None

Continuation of Laboratory Management A

APPENDIX

APPROVED COURSES FOR GRADES 7-12

Subjects or Courses	Grade Placement	Semester Time (7-8) or Credit (9-12)	Prerequisite and Other Information
SCIENCE	7-8	130 clock hours, required minimum	
LIFE SCIENCE			
Diversity of Plants and Animals	7-8	65 clock hours, minimum	
Biological Processes	7-8	65 clock hours, minimum	
Survey of Life Science	7-8	65 clock hours, minimum	
APPLIED LIFE SCIENCE			
Living Things and Their Environment	7-8	65 clock hours, minimum	
Applications of Life Science	7-8	65 clock hours, minimum	
People's Environment	7-8	65 clock hours, minimum	
EARTH SCIENCE			
Geology and Oceanography	7-8	65 clock hours, minimum	
Weather and Astronomy	7-8	65 clock hours, minimum	
Survey of Earth Science	7-8	65 clock hours, minimum	
APPLIED EARTH SCIENCE			
Minerals and Lapidary	7-8	65 clock hours, minimum	
The Earth: Its History and Its Neighbors	7-8	65 clock hours minimum	
Energy	7-8	65 clock hours, minimum	

Approved Courses for Grades 7-12, continued

Subjects or Courses	Grade Placement	Semester Time (7-8) or Credit (9-12)	Prerequisite and Other Information
PHYSICAL SCIENCE			A student who completes the courses in Grade 7 and/or 8 should not repeat the courses in Grades 9-12
Introduction To Physics	7-8	65 clock hours, minimum	
Introduction to Chemistry	7-8	65 clock hours, minimum	
Survey of Physical Science	7-8	65 clock hours, minimum	
APPLIED PHYSICAL SCIENCE			A student who completes the courses in Grades 7 and/or 8 should not repeat the courses in Grades 9-12
Fundamentals of Physics	7-8	65 clock hours, minimum	
Fundamentals of Chemistry	7-8	65 clock hours, minimum	
Applications of Physical Science	7-8	65 clock hours, minimum	
SCIENCE	9-12	Two units in science, Grades 9-12, required as a minimum for graduation	(See Requirements for High School Graduation, *Principles, Standards, and Procedures for the Accreditation of School Districts,* TEA Publication AD7 825 01.)
PHYSICAL SCIENCE			
Introduction to Physics	9-12	½ unit	
Introduction to Chemistry	9-12	½ unit	
Survey to Physical Science	9-12	½ unit	

Subjects or Courses	Grade Placement	Semester Time (7-8) or Credit (9-12)	Prerequisite and Other Information
APPLIED PHYSICAL SCIENCE			
Fundamentals of Physics	9-12	½ unit	
Fundamentals of Chemistry	9-12	½ unit	
Applications of Physical Science	9-12	½ unit	
BIOLOGY I			
Cellular Biology	9-12	½ unit	
Plant and Animal Survey	9-12	½ unit	
Living Systems	9-12	½ unit	
APPLIED BIOLOGY			
Plants and/or Animals	9-12	½ unit	
Nutrition and Health Practices	9-12	½ unit	
Applications of Biology	9-12	½ unit	
BIOLOGY II			
Microbiology and Biochemistry	11-12	½ unit	1 unit of biology; 1 unit of chemistry (may be taken concurrently)
Organisms and Their Environment	11-12	½ unit	1 unit of biology; 1 unit of chemistry (may be taken concurrently)
Special Topics in Biology	11-12	½ unit	1 unit of biology; 1 unit of chemistry (may be taken concurrently)
PHYSIOLOGY AND ANATOMY			
Survey of Anatomy and Physiology—A	10-12	½ unit	

Approved Courses for Grades 7-12, continued

Subjects or Courses	Grade Placement	Semester Time (7-8) or Credit (9-12)	Prerequisite and Other Information
Survey of Anatomy and Physiology—B	10-12	½ unit	
Comparative Anatomy	10-12	½ unit	1 unit of biology
CHEMISTRY I			
Properties of Matter, Atomic Structure, and Solutions	9-12	½ unit	
Electrochemistry, Organic Chemistry, and Qualitative Analysis	9-12	½ unit	
Analysis	9-12	½ unit	
APPLIED CHEMISTRY			
Applications of Chemistry—A	9-12	½ unit	
Applications of Chemistry—B	9-12	½ unit	
Applications of Chemistry—C	9-12	½ unit	
CHEMISTRY II			
Atomic Theory, Properties of Matter, and Chemical Reactions	11-12	½ unit	1 unit of chemistry; 1 unit of physics (may be taken concurrently)
Kinetics and Equilibria	11-12	½ unit	1 unit of chemistry; 1 unit of physics (may be taken concurrently)
Special Topics in Chemistry	11-12	½ unit	1 unit of chemistry; 1 unit of physics (may be taken concurrently)
PHYSICS I			
Mechanics, Heat, and Sound	9-12	½ unit	

Subjects or Courses	Grade Placement	Semester Time (7-8) or Credit (9-12)	Prerequisite and Other Information
Light, Electricity, Magnetism, and Nuclear Physics	9-12	½ unit	
Electronics	9-12	½ unit	
APPLIED PHYSICS			
Applications of Physics—A	9-12	½ unit	
Applications of Physics—B	9-12	½ unit	
Applications of Physics—C	9-12	½ unit	
PHYSICS II			
Mechanics and Thermodynamics	11-12	½ unit	1 unit of physics; 1 unit of chemistry (may be taken concurrently)
Electricity, Magnetism, and Electronics	11-12	½ unit	1 unit of physics; 1 unit of chemistry (may be taken concurrently)
Special Topics in Physics	11-12	½ unit	1 unit of physics; 1 unit of chemistry (may be taken concurrently)
GEOLOGY			
Physical and Historical Geology	9-12	½ unit	
Gems and Minerals	9-12	½ unit	
Special Topics in Geology	9-12	½ unit	
METEOROLOGY			
Measuring and Reporting the Weather	9-12	½ unit	
Cycles and Circulation of the Atmosphere	9-12	½ unit	

Approved Courses for Grades 7-12, continued

Subjects or Courses	Grade Placement	Semester Time (7-8) or Credit (9-12)	Prerequisite and Other Information
Special Topics in Meteorology	9-12	½ unit	
ASTRONOMY			
The Solar System	9-12	½ unit	
Star Cycles and Practical Astronomy	9-12	½ unit	
Special Topics in Astronomy	9-12	½ unit	
MARINE SCIENCE			
Physical and Chemical Oceanography	9-12	½ unit	
Biological Oceanography	9-12	½ unit	
Special Topics in Oceanography	9-12	½ unit	
ENVIRONMENTAL SCIENCE			
Energy and the Environment	9-12	½ unit	
Ecology	9-12	½ unit	
Special Topics in Environmental Science	9-12	½ unit	
LABORATORY MANAGEMENT	10-12	½-1 unit	Credit granted for student management of science course.

ORIGIN OF THE FRAMEWORK MATRIX

The science program described in this document is built around the individual student, and her or his self-concept, career choice, individual goals, and role in society. It is permeated with both mental and physical student-centered activities. When these elements were organized into a pattern, the Science Framework Matrix, pages 60-62, emerged as a vehicle for showing the relationship between "What People Do" and "What Schools Do." The role of the school (What Schools Do) then becomes that of providing experiences which help the individual develop the values, attitudes, skills (both cognitive and psychomotor), and knowledge which enable him or her to function in the areas of concern (What People Do).

An activity oriented science program is an instructional vehicle which lends itself to developing the psychomotor and rational thinking processes of individuals. The activity approach is advocated in the science framework. In addition, the acquisition of knowledge and the relationships of individuals and their everyday problems to science (and technology) can be readily identified in the Science Framework Matrix. For example, one can immediately see that psychomotor activities in a life science laboratory can be related to development of career work skills, of mechanical aptness as consumers, or of creativity in a hobby. Similar application of rational thinking skills to consumer behavior, use of leisure time, and cultural awareness can be seen in the Framework Matrix.

SCIENCE FRAMEWORK MATRIX

WHAT PEOPLE DO

WHAT SCHOOLS DO	—A— Living with Self	—B— Career Choices	—C— Consumer Choices	—D— Leisure Choices	—E— Living with Others (Culture)
1 Values, Attitudes, Aspirations	A-1	B-1	C-1	D-1	E-1
2 Process Skills (Rational Thinking Skills)	A-2	B-2	C-2	D-2	E-2
3 Psychomotor (Manipulative Skills)	A-3	B-3	C-3	D-3	E-3
4 Knowledge	A-4	B-4	C-4	D-4	E-4

Living with Self, Column A of the Matrix, implies that a person should be able to interact in a positive way with the environment. As this function of What People Do relates to What Schools Do, it means that:

In terms of values, attitudes, and aspirations in science,

A_1 a person has a belief in herself or himself in her or his worthwhileness as an individual and confidence in her or his ability to control part of her or his environment

In terms of rational thinking skills in science,

A_2 a person has the ability to organize thought processes to accomplish goals

In terms of manipulative skills in science,

A_3 a person has the competencies essential for acquiring and handling selected materials in the environment to accomplish personal goals

In terms of science knowledge,

A_4 a person has sufficient understanding of science to maintain personal, mental, and physical health to achieve fulfillment in the environment

Career Choices, Column B of the Matrix, implies that students should become knowledgeable about various careers and see the usefulness, application, and direction of specific careers. As this function of What People Do relates to What Schools Do, it means that:

In terms of values, attitudes, and aspirations in science,

B_1 the student can perceive career choice as being of value to self and society

In terms of rational thinking skills in science,

B_2 a student is able to evaluate career choices and actions

In terms of manipulative skills in science,

B_3 a student has competency in the use of basic materials applicable to a variety of possible careers

In terms of science knowledge,

B_4 a student has information concerning the kinds of careers available and understands the basic prerequisites for a variety of possible career choices

Consumer Choices, Column C of the Matrix, implies that a person interacts with the environment by selecting and using a commodity or service wisely. As this function of What People Do relates to What Schools Do, it means that:

In terms of values, attitudes, and aspirations in science,

C_1 a person values consideration of the consequences of his or her actions

In terms of rational thinking skills in science,

C_2 a person evaluates endorsements, advertisements, products, and services by using rational thinking processes

In terms of manipulative skills in science,

C_3 a person has the mechanical skills essential for using and maintaining the technological materials and devices he or she encounters as a consumer

In terms of science knowledge,

C_4 a person has sufficient understanding of scientific principles and concepts to enable him or her to make reasonable technological application to the materials and devices encountered in daily life

Leisure Choice, Column D of the Matrix, implies that a person can occupy free time in a manner pleasing to self and others. As this function of What People Do relates to What Schools Do, it means that:

In terms of values, attitudes, and aspirations in science,

D_1 a person has a sense of personal worth in doing things for personal pleasure as well as in doing things for others

In terms of rational thinking skills in science,

D_2 a person has the capacity and desire to make logical decisions concerning the wise use of leisure time and materials

In terms of manipulative skills in science,

D_3 a person has the physical skills that provide enjoyment in recreational and avocational activities

In terms of science knowledge,

D_4 a person has, or knows how to acquire, the understanding that enables full development and pursuit of interests during free time

Living with Others (Culture), Column E of the Matrix, implies that an individual has learned to interact with other people in ways that conserve his or her lifespace. As this function of What People Do relates to What Schools Do, it means that:

In terms of values, attitudes, and aspirations in science,

E_1 the individual is aware of the desirability of applying scientific knowledge in a manner that results in optimum benefit for people

In terms of rational thinking skills in science,

E_2 an individual is able to adjust constructively to variations in needs resulting from individual differences that exist both within and among cultures in a healthy society

In terms of manipulative skills in science,

E_3 a person has developed skills in utilizing materials and devices in a manner that minimizes danger to self and to society and maintains an acceptable level of erosion of the environment

In terms of science knowledge,

E_4 a person has acquired an understanding of the interactions of science, technology, and society and is able to place these relationships in historical and contemporary perspective

INTEGRATION OF SCIENCE CONCEPTS

Basic scientific concepts have some degree of application in all phases of human activity. The extent or degree of application is dependent on the individual's need, aptitude, interest, and ability. Science learning activities should incorporate experiences which are human-centered. The activities should provide channels whereby a student can have an in-depth learning experience tailored to his or her personal interest or commitment at any given time. Learning activities should help each individual build concepts which contribute to a feeling of personal worth, to choice of a satisfying career, to prudent behaviors as a consumer, to creative uses of leisure time, and to a realization of a positive role in society. Learning activities should also provide realization of learner objectives that emphasize knowledge, process skills, psychomotor skills, and development of value systems.

It is not necessary that cells in the Integration of Science Framework Matrix below be given equal emphasis in designing an individual's program.

INTEGRATION OF SCIENCE FRAMEWORK MATRIX

WHAT PEOPLE DO

WHAT SCHOOLS DO	—A— Living with Self	—B— Career Choices	—C— Consumer Choices	—D— Leisure Choices	—E— Living with Others (Culture)
1 Values, Attitudes, Aspirations	A-1 Belief in Myself	B-1 Commitment	C-1 Consideration of Consequences	D-1 Worthy Choices	E-1 Concern for People
2 Process Skills (Rational Thinking Skills)	A-2 Organization Thought Processes	B-2 Decision-Making	C-2 Product and Service Selection	D-2 Logical Decisions	E-2 Constructive Adjustment
3 Psychomotor (Manipulative Skills)	A-3 Competence in Handling Materials	B-3 Use of Basic Materials	C-3 Mechanical Aptness	D-3 Creative Application	E-3 Self Practices
4 Knowledge	A-4 Mental and Physical Well-Being	B-4 Choice and Competence	C-4 Technical Application	D-4 Hobbies and Recreation	E-4 Interactions of Science, Technology, and Society

SUGGESTED PROCEDURES FOR IMPLEMENTING THE SCIENCE FRAMEWORK

Procedures for implementing the science framework in the elementary, middle, and secondary schools will vary over the state. Implementation in elementary schools should pose minimum problems in scheduling since many of the students at a grade level will be involved in the same unit of study. Individualization can be encouraged through variations in time and depth of instruction in a given module.

No sequence is specified in the courses for middle school, Grades 6-8. However, local school districts may introduce sequencing where desirable. Each school district should choose the specific grade levels at which a course will be offered (within the range given).

Since only two semester science courses are required in Grades 7-8, a course would not need to be repeated if failed by a student unless the school district specified a sequence or requires that a failed course be repeated. Not requiring a student to repeat will reduce the requirements for trailer courses and will simplify the task of assigning teachers.

In Grades 9-12, the introduction of the semester course plan of the science framework would be simplified through use of computer facilities. Schools without such assistance need to plan in advance to permit teachers freedom in blocking courses into a sequence that will provide meaningful instruction to meet the needs of students.

In most cases, a total of three semester courses are listed for each year of instruction. A school may offer all three semester courses and give the student an opportunity to elect two, or a school may choose to offer only two of the three listed and specify sequence. This may be done in both middle and high school.

Each semester course may be taken independently, in which case the student will receive one semester credit. Students preparing for college should be counseled to take two semesters of biology and two semesters of chemistry and/or physics as a minimum. An exception would be when the student receives credit for certain semester courses via exams and/or extension courses.

Local coordinating committees can be organized to facilitate the process of curriculum building, in both establishing the sequence of courses and the grade levels at which they will be offered. Instructional material will be available through textbook adoption procedures; however, if school personnel wish to develop material for a particular course, they are encouraged to do so.

COMPLIANCE STATEMENT

TITLE VI, CIVIL RIGHTS ACT OF 1964; THE MODIFIED COURT ORDER, CIVIL ACTION 5281, FEDERAL DISTRICT COURT, EASTERN DISTRICT OF TEXAS, TYLER DIVISION

Reviews of local education agencies pertaining to compliance with Title VI Civil Rights Act of 1964 and with specific requirements of the Modified Court Order, Civil Action No. 5281, Federal District Court, Eastern District of Texas, Tyler Division are conducted periodically by staff representatives of the Texas Education Agency. These reviews cover at least the following policies and practices:

(1) acceptance policies on student transfers from other school districts;

(2) operation of school bus routes or runs on a non-segregated basis;

(3) nondiscrimination in extracurricular activities and the use of school facilities;

(4) nondiscriminatory practices in the hiring, assigning, promoting, paying, demoting, reassigning, or dismissing of faculty and staff members who work with children;

(5) enrollment and assignment of students without discrimination on the basis of race, color, or national origin;

(6) nondiscriminatory practices relating to the use of a student's first language; and

(7) evidence of published procedures for hearing complaints and grievances.

In addition to conducting reviews, the Texas Education Agency staff representatives check complaints of discrimination made by a citizen or citizens residing in a school district where it is alleged discriminatory practices have occurred or are occurring.

Where a violation of Title VI of the Civil Rights Act is found, the findings are reported to the Office for Civil Rights, Department of Health, Education and Welfare.

If there is a direct violation of the Court Order in Civil Action No. 5281 that cannot be cleared through negotiation, the sanctions required by the Court Order are applied.

TITLE VII, CIVIL RIGHTS ACT OF 1964; EXECUTIVE ORDERS 11246 AND 11375; TITLE IX, 1973 EDUCATION AMENDMENTS; REHABILITATION ACT OF 1973 AS AMENDED; 1974 WAGE-HOUR LAW AMENDMENTS; AND VIETNAM ERA VETERANS READJUSTMENT ASSISTANCE ACT OF 1972 AS AMENDED

It is the policy of the Texas Education Agency to comply fully with the nondiscrimination provisions of all federal and state laws and regulations by assuring that no person shall be excluded from consideration for recruitment, selection, appointment, training, promotion, retention, or any other personnel action, or be denied any benefits or participation in any programs or activities which it operates on the grounds of race, religion, color, national origin, sex, handicap, age, or veteran status (except where age, sex, or handicap constitute a bona fide occupational qualification necessary to proper and efficient administration). The Texas Education Agency makes positive efforts to employ and advance in employment all protected groups.